Bio-Inspired Autonomous Systems

ONR Program Code 34

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At a Glance

What it is

- A program that extracts principles of sensorimotor control, sensing and biomechanics from biological systems to design advanced vehicle prototypes that exceed current engineering capabilities
- Explores novel approaches to human-robot interaction

How it works

- Efficient propulsion mechanisms based on animal biolocomotion are combined with adaptive nonlinear neural controllers and bio-inspired sensing and navigation to produce new vehicles that are efficient, low-noise, highly maneuverable and capable of long mission duration.

What it will achieve

- Expand the operational envelope of naval autonomous systems
- Enable autonomous underwater vehicles that are both maneuverable and have a long duration
- Enable underwater vehicles that are stealthy and agile

Point of Contact

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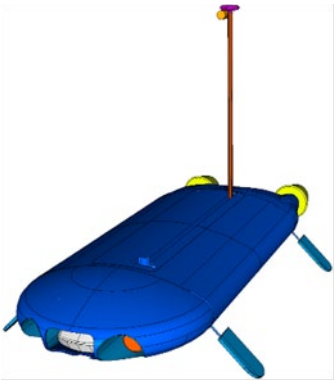
The Office of Naval Research (ONR) biorobotics program focuses on bioinspired autonomous undersea vehicles with additional work in micro air vehicles and humanoid robots to support human-robot interaction research.

Accomplishments include:

Neuroscience research into neuromotor control circuits controlling movement patterns led to an analog nonlinear neural controller to produce precise adaptive synchroniziation of a 6-foil underwater vehicle.

Analysis of the fluid dynamics of fly wings and fish fins led to new principles for high-lift propulsion due to dynamic stall mechanisms. High-lift pitching and heaving foils developed at NUWC have been able to capture this efficient propulsion on prototype underwater vehicles. These vehicles are quiet, highly maneuverable and capable of operating for weeks with current battery technology.



Research into biosonar, electrosense and lateral line sensors is leading to new search and identification capabilities.

Research Challenges and Opportunities

- Extracting principles and implementing efficient bio-propulsion and control surfaces
- Developing adaptive controllers for high-degree-of-freedom bio-inspired locomotion
- Integrating biosensing, bionavigation, locomotion and closed-loop control to enable agile vehicles operating in complex environments
- Developing muscle-like actuators
- Developing vehicles that can support high-level human autonomous system interaction, including within shared spaces
- Developing the capabilities for micro air vehicles to perch and grasp